Environmental Site Assessment

- It is important to understand the various approaches used to investigate and remediate an impacted site.
- It is important to know what is required and accepted, as well as what is possible.

Course Objective

Present a framework for understanding the environmental site assessment process & procedures

Environmental Site Assessments

Phase I ESA: compile, integrate & interpret existing information, including current & historic records, photographs and maps. ASTM E1527-00 defines this process.

✔Environmental Data Resources, Inc. – www.edr.com

✔Vista Environmental Graphics Data – www.esri.com/data/online/vista/

✔GeoTracker – www.geotracker.swrcb.ca.gov

✔Envirofacts – www.epa.gov/enviro/index_java.html

Environmental Site Assessments

Phase II ESA: generally involve intrusive sampling and analytical methods to determine the degree of site contamination. ASTM E1903-97 defines this process

The decision-making framework for site assessment centers around the development and validation of the Conceptual Site Model (CSM)

Site Assessment Decision-Making

Each site has particular risk factors:

- Risk Factors Related to Receptors
- Risk Factors Related to Pathways
- Risk Factors Related to Sources

Receptors depend on groundwater usage
Pathways depend on hydrogeology
Sources depend on release scenario & hydrogeology

TOGETHER, THESE RISK FACTORS FORM THE CONCEPTUAL MODEL OF THE SITE

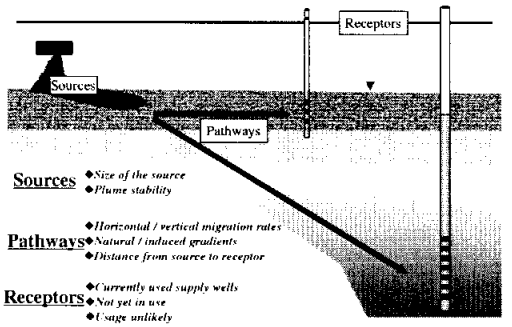
Conceptual Site Model (CSM)

- ✓ **A written or pictorial representation of a release scenario and the likely distribution of chemicals at the site**
- ✓ **Identifies potential current and future receptors**
- ✓ **Identifies what the subsurface looks like**
- ✓ **Identifies what chemical are present and where**
- ✓ **Identifies the distribution of chemicals in space and time**
- ✓ **Identifies how the distribution of chemicals are changing in in space and time**

- ✓ **Links potential sources to potential receptors through transport of chemicals in air, soil and water (pathways)**
- ✓ **Identifies fate & transport characteristics of the site**
- ✓ **Identifies environmental issues that need to be investigated (and those issues that do not need to be addressed)**
- ✓ **Provides a framework for the entire project and a communication tool for the regulators, PRPs, and other stakeholders**

CSM is the cornerstone of good ESA

Generalized Conceptual Site Model

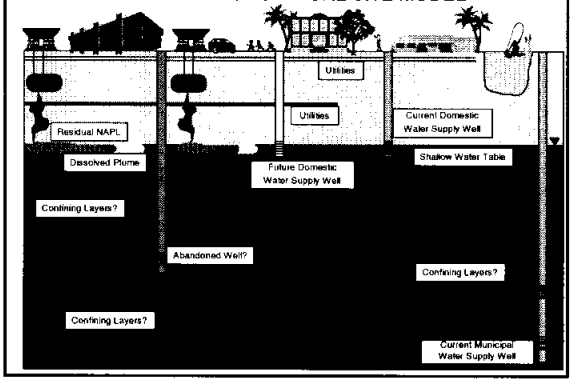


Sources
- *Size of the source*
- *Plume stability*

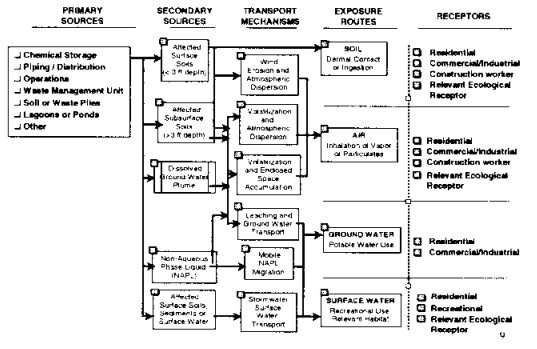
Pathways
- *Horizontal / vertical migration rates*
- *Natural / induced gradients*
- *Distance from source to receptor*

Receptors
- *Currently used supply wells*
- *Not yet in use*
- *Usage unlikely*

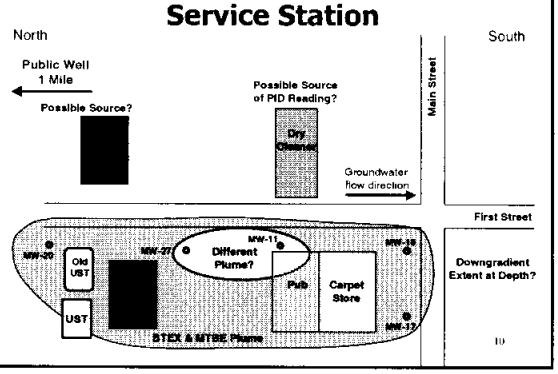
A GENERAL CONCEPTUAL SITE MODEL



Site Conceptual Exposure Model (ASTM PS-104-98)



Conceptual Site Model
Service Station



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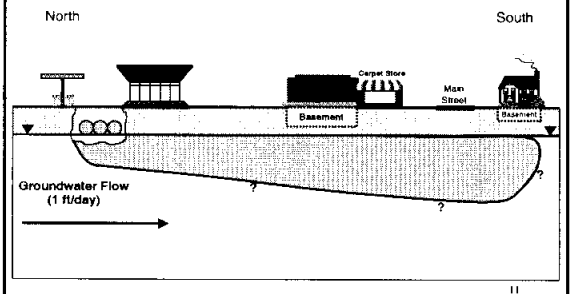
Conceptual Site Model
Service Station



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Conceptual Site Model
Service Station

Primary Sources	Secondary Sources	Exposure Routes	Receptors
Former USTs Former waste oil tanks Former dispensing pumps	Impacted soil	Soil Dermal contact or ingestion	• construction worker • commercial • residential
Former floor drains Potential current USTs	NAPL	Air Inhalation	• construction worker • commercial • residential
Off site sources • Station B • Dry cleaner	Dissolved groundwater	Groundwater Ingestion	• residential

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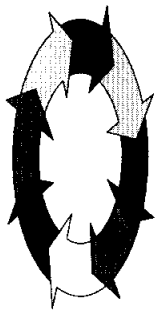


Development of the conceptual model is an iterative process; the model is refined as new data become available.

Investigation continues in an iterative fashion until the CSM no longer changes enough to affect *remedy* decision

Conceptual Site Model Development

The first step towards site conceptual model development, is the preliminary site assessment. This commonly involves the following field activities:

1. **Historical Assessment**
2. **Physical Assessment**
3. **Geologic / Hydrogeologic Assessment**
   stratigraphy, depth to water, direction and rate of flow etc.
4. **Contaminant Assessment**
   type and distribution of chemicals in time and space
5. **Stakeholder Assessment**

Conceptual Site Model Presentation

To facilitate discussion, the SCM should include *at least*:

1. Local and regional plan view maps
   location of sources, extent of contamination, direction and rate of ground water flow, locations of receptors
2. Geologic cross-section maps
   subsurface geologic features, man-made conduits, extent of contamination
3. Plots of chemical concentrations Vs. time
4. Plots of chemical concentrations Vs. distance from the source
5. Summary tables of chemical concentrations in different media
6. Well-logs, boring-logs, well survey maps

Conceptual Site Model Validation

Most commonly asked question: is site investigation adequate ?

- ❒ This question should always be linked to the SCM.
- ❒ Ask, "if additional data is collected, is it probable that the SCM would change? Would answers to the basic questions listed above change"
- ■ If the answer is "no", then the existing site investigation data in adequate

CSM Validation

❶ Water well survey
- Domestic wells
- Municipal wells
- Irrigation wells
- Construction details of the wells
- Pumping rates of the wells

❷ Hydraulic definition and contour maps
- Identify/define lateral & vertical groundwater flow regime
- Assess hydraulic communications

❸ Stratigraphy
- Generate detailed geologic cross sections
- Understand the stratigraphy of the unsaturated zone and the zone of saturation.

Aralewanthum and Buscheck, 1999

❹ Contaminant delineation & plume contours
- Understand how the monitor well's screened interval relates to the stratigraphy
- Understand how the screened interval affects the water level and concentration gradient in the zone of saturation.
- Identify/define horizontal & vertical extent
- Estimate horizontal & vertical migration rates

❺ Estimation of contaminant mass
- Extent of any floating product
- NAPL concen. above & below water table in source area
- Mass remaining in plume

❻ Conduit survey
- Sewers, water lines, electrical lines etc.
- Abandoned wells

Arulanantham and Buscheck, 1999

❼ Ground water & contaminant monitoring
- At least two years of continuous monitoring, using properly screened and constructed wells
- Establish plume contours
- Groundwater flow regime needs to be well-characterized

❽ Concentration versus time curves for source area wells
- Understand NAPL depletion rates
- Understand hydraulic influences

❾ Concentration versus distances for centerline wells
- Define plume stability over a time period - again, groundwater flow regime critical to doing this defensibly

Arulanantham and Buscheck, 1999

STATE OF CALIFORNIA

STATE WATER RESOURCES CONTROL BOARD

ORDER: WQ 98-03 UST
In the Matter of the Petition of
KENNETH AND JEAN FORTENBERY

"The evidence supports the finding that the concentrations of petroleum at petitioners' site do not pose a threat to human health, safety, and the environment, or to current or probable future beneficial uses. More specifically, the evidence indicates that the groundwater beneath petitioners' site has not been impacted at all."

First Closure Order

Fortenbery site located in Watsonville

(Region 3 - Central Coast RWQCB)

Available on the Internet at http://www.swrcb.ca.gov/resdec/wqorders/1998/wqo98-03.htm

STATE OF CALIFORNIA

STATE WATER RESOURCES CONTROL BOARD

ORDER: WQ 98-04 UST
In the Matter of the Petition of MATTHEW WALKER

"[T]he level of site cleanup is consistent with the maximum benefit to the people of the state and will meet the applicable objectives in the San Francisco Bay RWQCB Basin Plan within a reasonable time frame."

Second Closure Order

Walker site located in Napa

(Napa County Department of Environmental Management)

Available on the Internet at http://www.swrcb.ca.gov/resdec/wqorders/1998/wqo98-04.htm

STATE OF CALIFORNIA
STATE WATER RESOURCES CONTROL BOARD

ORDER: WQ 98-13 UST
In the Matter of the Petition of LANDIS INCORPORATED

"[C]onsidering the absence of existing wells in close proximity to petitioner's site, the local hydrogeologic considerations, and standard well construction practices which mandate (a) surface sanitary seals to preclude introduction of shallow groundwater . . . and (b) minimum distances from existing sewer lines and storm drains, the limited magnitude and extent of residual petroleum will not unreasonably affect existing or anticipated beneficial uses."

Sixth Closure Order

Landis site located in Ojai

(Ventura County Resource Management Agency, Environmental Health Division)

Available on the Internet at http://www.swrcb.ca.gov/resdec/wqorders/1998/wqo98-13.htm

STATE OF CALIFORNIA

STATE WATER RESOURCES CONTROL BOARD

ORDER: WQ 98-12 UST
In the Matter of the Petition of UNOCAL CORPORATION

"Thus, the available facts indicate (1) the presence of a localized plume in shallow groundwater which is stable, (2) conditions which will further diminish residual petroleum concentrations within that limited area in the future, and (3) there is little likelihood that shallow groundwater will be put to beneficial uses in the foreseeable future."

Fifth Closure Order

UNOCAL site located in Gilroy

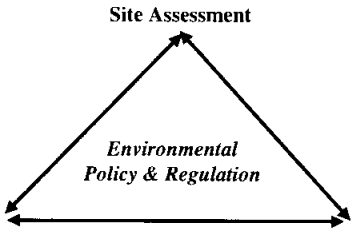
(Santa Clara Valley Water District)

Available on the Internet at http://www.swrcb.ca.gov/resdec/wqorders/1998/wqo98-12.htm

Risk Goals in Site Management

1. Adequate site characterization
2. Removal of F.P. to the extent practicable
3. Removal of primary source(s)
4. Achieve a stable or receding plume
5. Prevent current / future public health hazards
6. Prevent current / future ecological hazards
7. Prevent current / future water resources impairment
8. Post remediation risk management plan in place

Ravi Arulanantham, 1997



Risk Assessment

- explosive conditions
- nuisance conditions
- water quality, public health & environment

Risk Management &
Risk Communication

The Key Elements of Risk-Based Decision Making

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